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Analyzing the causes of non-development of renewable energy-related industries in Iran

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ABSTRACT

Energy crisis is one of the issues which have imposed many changes in the development of various technologies around the world. Every-year renewal of this crisis in different countries has led many of them to move towards alternative resources like renewable energies, and also to make changes in their energy consumption in order to expand the application of these resources.

By taking into account of Iran's high potential in renewable energies, and also its scheme to go towards actualizing the prices of energy carriers, and with the help of designing a flexible and dynamic structure and removing the existing obstacles, it is necessary to analyze the infrastructures, policies and administrative structures in the field of renewable energies in the country to accelerate their development.

This article tries to review the potentials of "renewable energies" (RE) in Iran and its current situation of RE related industries with an emphasis on achieving defined goals and objectives for the fourth national development plan, and also to discusses the barriers and causes of non-achievement of these objectives.

Contents

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1. Introduction

Iran, which is located in the Middle East, is known as an enrich country in terms of hydrocarbon resources. It holds the world's second largest natural gas reserves, and also the OPEC's second largest supply of oil.

With regard to proposed changes to actualize the prices of energy carriers due to required fuel and power supplies in Iran, the exploitation of renewable energy resources and development of these energies application have become more consequential. Currently, the share of 'renewable energies' in Iran's energy basket is insignificant. In 2007, the share of these energies from the total energy production was equal to 0.08 million barrels of crude oil (equivalent to 0.17% of the total energy produced) [1]. This is while the potentials of these energy resources within Iran, especially in some cases such as solar and wind energy, is higher than many successful and leading countries in this field.

Therefore, non-realization of Iran's goal in the fourth development plan to secure 1% of the country's total required electricity from renewable energy resources, and also non-realization of 62% of renewable energy power plants planned capacity, leads us towards reviewing the current relevant policies, proper use of scientific and technical potentials, and elimination of similar works in managerial and administrative systems in this field.

This paper discusses about the causes of non-development of the industries in the context of renewable energies in Iran.

The rest of the paper is organized as follows. In section a brief review of Iran's renewable energy potential is provided, and the current situation of active industries in this field is discussed in Section 3. A review on renewable energy policies and strategies are presented in Section 4, and renewable energy-related goals in the fourth development plan, and policy making and institutional structures are studied in Sections 5 and 6, respectively. After analyzing the causes of non-development of industries in the field of renewable energies in Iran in Section 7, we briefly conclude and discuss on research opportunities in Section 8.

2. Renewable energy potentials in Iran

2.1. Hydro power

Currently, water is considered as one of the most important renewable energy resources in Iran, and its potential for electricity production is about 50 TWh. By the end of 2007, total capacity of operating hydroelectric power plants was 7422.5 MW [1].

2.2. Wind energy

Wind is the second source of renewable energy in power generation in Iran. Based on studies carried out, Iran is a country with 6 m/s average wind speed. In some regions, there is more appropriate and consistent wind for power generation [2].

Iran is located in the main air flow path among Asia, Europe, Africa, Indian Ocean and the Atlantic Ocean and therefore is subject to:

- pressure center flow over Central Asia in winter;
- pressure center flow over Indian Ocean in summer;
- western flow from Atlantic and the Mediterranean Sea, especially in winter;
- Northwest flow during summer [3].

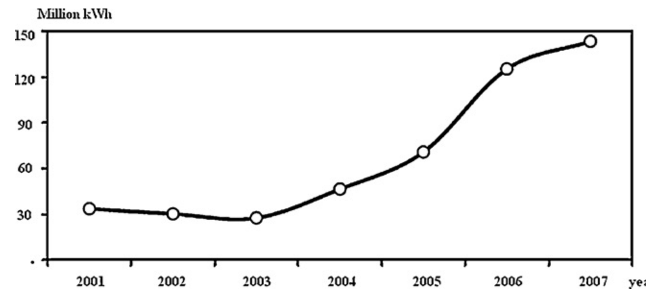


Fig. 1. Wind power generation in 2001–2007 [1].

In 2007, wind power generation was about 140 million kWh (Fig. 1) and the government has begun implementing policies to support private sector in this field.

2.3. Solar energy

Located on the world's Sun Belt; Iran enjoys 2800 sunny hours per year and its average solar insulation is estimated as 2000 kWh/m^2 year (Fig. 2) [4]. Therefore, Iran has an appropriate situation for using solar energy. The potential of Iran in using this source of energy is such that only by using 1% of the country's area, it can procure all the energy needs of the country [3].

Based on the statistics, total installed capacity of photovoltaic electricity generation systems in operation in Iran is 175 kW. In 2007, about 71,000 kWh of electricity was produced by Tehran 30 kW photovoltaic power plant and Darbid Yazd and Sarkavir Semnan power plants [1].

Solar PV off-grid electricity generation trend between the years 2001 and 2007 is illustrated in Fig. 3.

Besides, some activities have been done in the field of solar thermal systems application in Iran, launching the first phase of Shiraz solar thermal power plant with a capacity of 250 kW, is regarded as one of the most important projects. But despite previous plans based on the full launch of this plant until the end of the fourth national development plan, only its vapor phase has been implemented. Installation of approximately 18,000 solar water heaters was another activity in the field of household and office application of solar energy [1] but this is also good to note that no solar water heater was installed in the country in 2007.

During Iran's third and fourth national development plan, about 77,000 m^2 of solar collectors were installed [6]. However, the activities of other countries such as China, Germany and Turkey in this field remind us about the long way ahead of Iran in this regard.

2.4. Geothermal

Right now some projects in the field of exploitation of this potential are running in Iran. 60% progress of Meshkin-Shahr geothermal plant with a capacity of 370 million kWh per year, and 30% progress of Ardebil 3–5 MW plant with an annual production capacity of 40 million kWh are two main activities carried out in this field [1].

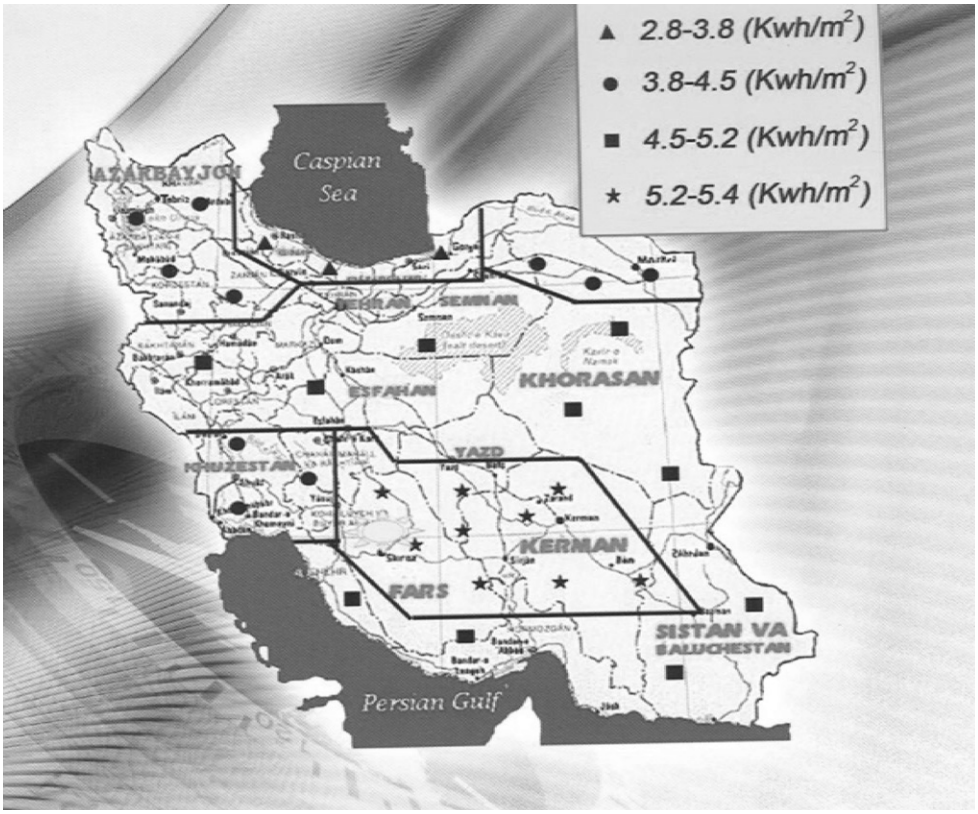


Fig. 2. Iran solar energy map [4].

2.5. Other renewable energy sources

Some activities with regard to other sources of renewable energy have been carried out by the Ministry of Energy of Iran, too. Installation and operation of a 25 kW polymeric Fuel Cell and also Designing and Manufacturing a 5 kg Polymeric Fuel Cell with the aim of achieving technical knowledge are some of the most important projects carried out in the field of fuel cells [1].

Besides, in the field of biomass, feasibility studies on biogas production in Saveh city (600 kW power), Mashhad biomass power plant (650 kW) and Shiraz biomass power plant (1060 kW) have been done and it is expected that the construction and operation of these plants will start soon [1].

In general, accurate estimation of the amount of Iran's energy supply from renewable sources indicates that the total installed capacity of renewable energy resources has reached more than 110 MW so far [6]. The trend of changes in the installed capacity by mid-2007 is described in Table 1.

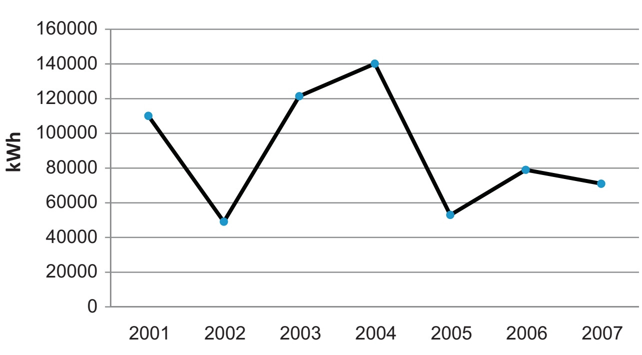


Fig. 3. Solar off-grid PV electricity generation in 2001–2007 in Iran [1].

3. RE equipment manufacturers in Iran

Currently, a limited number of manufacturers are active in the field of RE in Iran, but most of them are government owned companies. A review on the activities and growth of these companies, in wind and solar categories as the main fields of RE activities in Iran are as follows.

It is good to note that some other companies are also active in the field of wind and solar energy in Iran, but they are acting as foreign companies' agencies, and are not considered as manufacturers.

3.1. Manufacturers in the field of wind energy

There are two companies, which form the main body of wind energy instruments manufacturing sector, one of which is a government owned company that started its activities in 2000. This company designs medium and large sized wind turbines under the license of a Danish company and provides its products through technology transfer from other leading companies in the world. Huge national projects in this field are conducted by this company.

The other active manufacturer in this regard is the first public company which started its activities in the field of energy generation from renewable energy resources in 2007. This company concentrates on the production of small, medium and large sized wind turbines, and has registered 8 patents in this field. It has also produced small vertical axis wind turbines with a 100% Iranian technology.

As mentioned earlier, almost all important national projects are given to the government owned company and by this, the private sector would have no place to participate in the related activities

Table 1
Installed capacity in renewable energy sources between the years 1997 and 2007 [1,5].

	1997	2000	2003	2007
Solar energy				
Solar photovoltaic	5 kW	47 kW	170 kW	175 kW
Solar water heater	–	–	119 kW	4132 kW
Wind energy	1100 kW	10,100 kW	11,800 kW	73,990 kW
Small hydropower	4940 kW	7740 kW	9694 kW	36,050 kW
Total renewable energy resources	6045 kW	17,887 kW	21,783 kW	114,347 kW

and also there is a minimum investment in this area. Therefore, there was no significant growth in private sector activities and investments in the recent years.

3.2. Manufacturers in the field of solar energy

Manufacturers in this area can be divided into two categories.

3.2.1. PV manufacturers

The main PV manufacturers in Iran are 3 companies, one of them is a government owned company which has a production capacity equal to 3 MW and this is higher than the other two private companies' production. All of these companies manufacture poly and mono crystalline silicon solar panels, but only the government owned company is supported by the government.

3.2.2. Solar water heater manufacturers

Currently, 7 private companies are active in producing solar water heaters for household and industrial purposes, the largest of which, is the biggest contractor of Iranian Fuel Conservation Company (IFCO) and Renewable Energy Organization of Iran (known as SUNA).

4. Renewable energy policies and strategies

Following Iranian policy makers' attention towards replacing alternative energy resources for fossil fuels, Renewable Energy Organization of Iran (SUNA) with the help of World Bank has started to develop a strategic plan for Iran's renewable energies. This national project is now supervised by Renewable Energy Initiative Council of Iran (REIC) as its Steering Committee. So far, the draft of this document is prepared and is sent to a group of experts to get their feedbacks, but the final result is not publicized yet.

Besides that, Iran's renewable energy policies in the fourth five-year national development plan (2005–2009) are as follows [6]:

- Supporting private sector for dissemination of RE applications that are approaching economical viability, such as wind, geothermal and biomass energy.
- Supporting manufacturers for transferring and localization of RE technologies which are expected to become competitive in medium terms, such as PV systems and solar thermal power plants.
- Supporting the research centers to expand their research programs for RE technologies that are becoming competitive in longer than 10 years period.
- Providing sustainable and accessible energy to the poor and isolated areas.

In this context, government purchases the electricity produced by the private sector from renewable energy power plants with a price three times higher than the amount paid by consumers.

5. Objectives related to renewable energies in Iran's fourth national development plan

Based on the objectives introduced in Iran's fourth national development plan, it was planned to produce 500 MW of electricity from renewable energy resources by the end of 2009 (Table 2), which was equal to 1% of the country's energy basket. While, referring to the twenty-year vision, Iran is deemed to produce 10% of its required electricity from renewable sources by 2025.

6. Policy making and administrative structure of renewable energies in Iran

Renewable Energy Organization of Iran (SUNA) and Iran's Renewable Energy Initiative Council (REIC) are the two main administrative and policy making organizations involved in RE.

Following the Ministry of Energy policy, SUNA was established as a custodian in 1995. In addition to participating in the country's renewable energy strategies, this organization determines research priorities, implements basic projects in this field such as providing renewable energy map, and performs executive projects such as installing off-grid PV systems in rural areas. In order to build up the private sector's participation and to develop the production and consumption capabilities of renewable energies in Iran [4], it is necessary for this organization to follow the technological development trends, and also identify and attract some of international resources.

In July 2008, the other organization called "Iran Renewable Energy Initiative Council" (REIC) was formed in Research Institute of Petroleum Industry (RIPI), under the Presidential Department of Science – Technology as a national-level hub in order to coordinate and expedite the attempts to deploy renewable energies in Iran. Ministries and organizations involved in REIC formation are shown in Fig. 4.

REIC aims to consolidate and strengthen the scattered attempts in the field of renewable energies by the involved parties. Activating human and financial resources, avoiding similar works, making the activities clear in the renewable energy-related organizations and research commercializing in this field are from other objectives defined in this council.

Table 2
Objectives of the fourth development plan with regard to renewable energies (2005–2009) [7].

Small hydro-power plants	80 MW
Wind power plant	250 MW
Geothermal power plant	100 MW
Solar thermal power plant	17.25 MW
Fuel cell	1 MW
Photovoltaic	3 MW
Biomass	26.5 MW
Total	477.75 MW
Solar water heater (1,000,000 m^2)	50 MWh

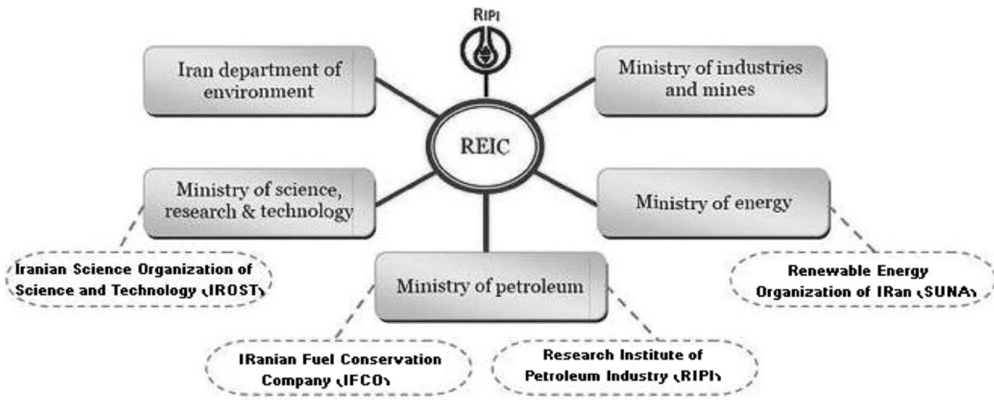


Fig. 4. Ministries and organizations involved in REIC formation [5].

This council consists of 7 specialized committees in different sectors of renewable energies, and supports knowledge-based companies and educational and research centers.

Besides that, reviewing budget allocation, evaluation of scientific-technical companies and organizations, and also compiling national renewable energy document and a road map are the areas of their activities [5].

In addition to these two governmental agencies that construct the main part of Iran's administrative structure of renewable energy sector, part of the budget allocated to development of renewable energies is paid to organizations such as Iranian Fuel Conservation Company (IFCO), Iranian Research Organization for Science and Technology (IROST), Iran Department of Environment, Ministry of Industries and Mines, Energy Ministry and Petroleum Ministry for projects and administrative research activities.

7. Discussion on Iran's goal achievements in the field of RE power plants

The most important fact to pay attention in this regard is that based on the available statistics, only 38% of the goals of Iran's fourth national development plan in the construction of renewable energy power plants has been achieved [8]. Chart 1 illustrates the percentage of goal achievement in the fourth development plan. As it is seen, the goals are not satisfied in this 5-year period, and the highest goal achievement is related to the time interval between the first and second year in the program which is still less than half the target.

Since Iran has a high potential in the field of renewable energies due to its specific geographical location, lack of access to renewable energy resources cannot be mentioned as a reason for not achieving the specified goals. However, some reasons such as lack of required funds to conduct projects, limited consultants, contractors and competent observers, highly time consuming for creation of new technical and scientific potentials, slow process of contracting and existing barriers to start new contracts are mentioned as the main obstacles by some authorities.

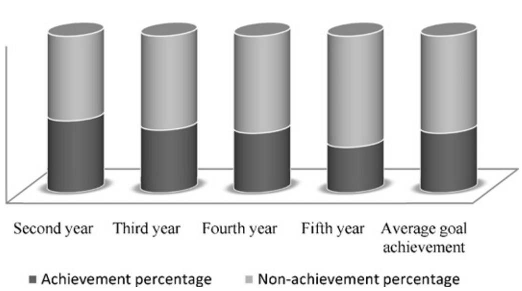


Chart 1. Percentage of goal achievement in Iran's fourth development plan in the field of practical construction of RE power plants.

But we should note that the gap between the targeted and achieved goals is so huge that the above mentioned reasons by the authorities cannot be considered as the main problems in this field. Instead, problems in the field of guidance, management, planning and implementing the programs are of great importance. The most important factors from this point of view are discussed as the followings:

7.1. Lack of dynamic strategic management team

Obviously, at the time of formulating every long term development plan, intended funds for planned projects are considered and placed to relevant organizations at the time of the start. Objectives and goals are also defined with regard to short-term and long-term intended projects. Therefore, if we face budget constraints, those projects which help us move towards the achievement of the specified objectives more than the other projects in the specified time limitation should be our first priority. Thus, planning and managing the specified budgets should be done towards maximizing goal achievement in a specified timeframe. This is only possible through a dynamic strategic planning which is led by a capable and dynamic management team.

7.2. Non-effective policies

Proper governmental policies, as the main influencing factor on market and industrial development, accelerate the competitive businesses growing and maximizing private investments in renewable energy sector. In most of the progressive countries, dynamic supporting and encouraging policies are the main stimulus to create new businesses and private sector activities in the field of renewable energies.

Although late in Iran, some policies regarding the guaranteed purchase of electricity produced from renewable energy sources are laid; but enforcement mechanisms focus mainly on wind energy sector, lack of technology transfer policies for the market, lack of policies for strengthening innovative activities, and more importantly, non-effectiveness of policies to attract capitals, make it necessary to review them in order to develop industrial activities in this sector.

7.3. Non-optimal utilization of human resources

By taking advantage of the potential of various scientific associations across the country, particularly in the field of renewable energies, active professionals and experts in the renewable energy

industry and also related professionals and academic research institutions, would solve most of the problems in the fields of lack of consultants, contractors and supervisors. This is while the potential and effectiveness of active specialists in this country has not been properly recognized, yet, and if this huge force in the society is discovered and guided properly, it will result in significant progression.

One important fact here is the lack of effective cooperation models between renewable energy industries, particularly private sector, and custodian organizations. Technical potential of this class can be very useful for the custodian organizations in project implementations.

In addition, although training young professionals in this area requires time and investment for several years, but even right now, there are a lot of interested experts in this section, whose ideas and capabilities can help Iran to move towards achieving its goals, if a chance is given to them.

7.4. Problems in the administrative and policy making structure of renewable energy in Iran

Vertical organizational structure with multiple layers, lack of transparency and separation of duties, and the existence of similar duties in many of the executive parts result in delay and low level of accuracy in executing the work in the RE organizations. Certainly, if there is an appropriate separation of duties in internal and external levels, and also enough transparency is done, efficiency will increase in the system. Besides, a Quality Control Manager should be defined in the system to monitor the factors and processes.

Similar activities of SUNA and REIC can be mentioned as an example of similar works in Iran's renewable energy organizational structure.

However, if each responsibility is specifically defined for one organization, firstly, by reducing the number of tasks, each organization can become specialized in doing them; secondly, it will prevent clients, employees and clerks from confusion caused by the differences in management systems; and third, the initial budget is appropriately divided among them.

7.5. Lack of appropriateness between the defined goals and the existing management power

Some of the existing problems in RE planning for industrial development in Iran are due to setting goals beyond the existing management and administrative capacity which results in losing motivation to achieve the defined objectives.

Since in a successful management system, goals must be SMART (Specific, Measurable, Achievable, Realistic, Time Bounded), if problems such as inadequate funding or lack of specialists can be considered as good reasons for non-achievement of defined goals in a way that it is not possible to solve them in a reasonable time frame, it should be possible to adjust goals in a way that, despite it is not easy, it is possible.

On the other hand, considering such a big goal at the beginning of implementing the fourth development plan (or other similar plans) may motivate the organizations to follow it, but not being able to achieve the specified goals in the primary levels due to various problems would discourage them to continue. Therefore, considering possibility for reviewing and modifying the goals set in the system or the system governing the administrative processes in the field of renewable energies in Iran can help realizing the defined goals and also motivating officials and employees in this sector to move appropriately towards goal achievements. It should also be noted that even in case of objectives adjustment; current administrative structure of Iran's renewable energy sector should be reformed and invigorated to achieve maximum goals set.

8. Conclusion

By considering the potentials of Iran in the field of renewable energies, and the causes of failure in the development of industries in this field, therefore, we are able to analyze the structure of the system as follows:

- Lack of adequate and effective planning for executive section in the field of renewable energies.
- Lack of transparency and separation of duties between and within the organizations in their administrative and executive policies for renewable energies.
- Lack of specific cooperation models between active specialists in industry and the custodian organizations.
- Lack of proper use of specialists and technicians in the country.

Therefore, it is obligatory to make changes in policy making and administrative structure in Iran's renewable energy sector in order to accelerate the achievement of the objectives specified in the five-year development plans of Iran.

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